

SECTION 3

I'VE GOT THREE STATES

OUTCOME: WHAT STUDENTS WILL LEARN

- Students will understand and identify the three states of water – solid, liquid and gas.

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CORE CONTENT STANDARDS

Science

- SC-E-1.1.1 Objects have many observable properties such as size, mass, shape, color, temperature, magnetism and the ability to react with other substances. Some properties can be measured using tools such as metric rulers, balances, and thermometers.
- SC-E-1.1.3 Materials can exist in different states – solid, liquid and gas. Some common materials, such as water, can be changed from one state to another by heating or cooling.
- SC-E-2.1.1 Earth materials include solid rocks and soils, water and the gases of the atmosphere. Minerals that make up rocks have properties of color, texture and hardness. Soils have properties of color, texture, the capacity to retain water, and the ability to support plant growth. Water on Earth and in the atmosphere can be a solid, liquid, or gas.
- SC-E-2.1.2 Earth materials provide many of the resources humans use. The varied materials have different physical and chemical properties, which make them useful in different ways, for example, as building materials, as sources of fuel, or growing the plants we use as food.
- SC-M-2.1.5 Water which covers a majority of the Earth's surface, circulates through the crust, oceans and atmosphere in what is known as the water cycle.

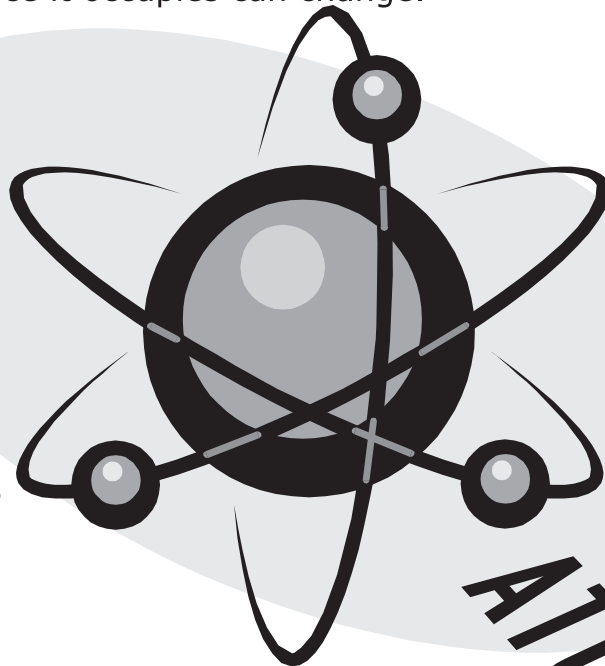
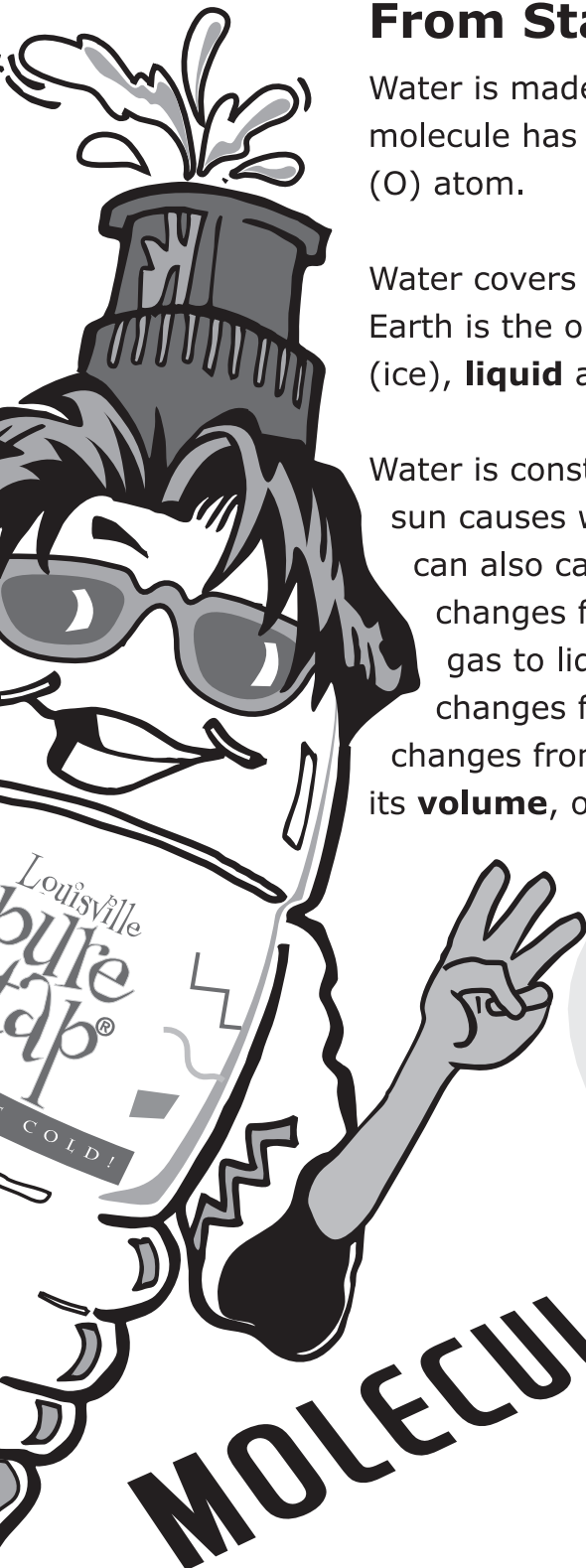
I'VE GOT THREE STATES

From State to State

Water is made up of **molecules** – tiny particles called **atoms**. A water molecule has three atoms: two hydrogen (H) atoms and one oxygen (O) atom.

Water covers 75% of the Earth. It is tasteless, odorless and colorless. Earth is the only planet where water can exist in all three forms: **solid** (ice), **liquid** and **gas** (vapor).

Water is constantly changing from state to state. The energy from the sun causes water to **evaporate** into a gas. Boiling water on a stove can also cause water to change from a liquid to a gas. As water changes from a solid to a liquid it melts. As water changes from gas to liquid, it is called **condensation**. Water **freezes** as it changes from a liquid to a solid. Water becomes **frost** when it changes from a gas to a solid. As water changes from state to state its **volume**, or the space it occupies can change.



MOLECULES

ATOMS



Solid (Ice)

Water is ice in **glaciers** at the North and South Poles. When water is in this state, it can float. Ice floats because as water freezes it becomes lighter – it weighs less than liquid water.

Liquid

Water is a liquid in lakes, rivers, oceans and streams. This is the state of water we're most familiar with. It's also how most of the water exists on Earth. We drink, wash, cook and use liquid water in many ways every day!

Gas (Vapor)

Water is always a gas. It's always part of the air we breathe. Water is also a gas when it's in the atmosphere as clouds. Water vapors can form raindrops, snowflakes or hail, depending on the weather conditions.

NOTE:

This section is designed as a preface to Section 4 that deals with the water cycle.

WATER WORDS

Atom: the smallest particle of an element.

Condensation: the change of water from a gas to a liquid.

Evaporation: the change of water from a liquid to a gas.

Freezing: Process of water changing from a liquid to a solid.

Frost: the change of water from a gas to a solid.

Gas: a state of matter; a gas always has the same shape as the container it fills. It has a changing volume.

Glacier: water as ice; glaciers are found in the North and South Poles.

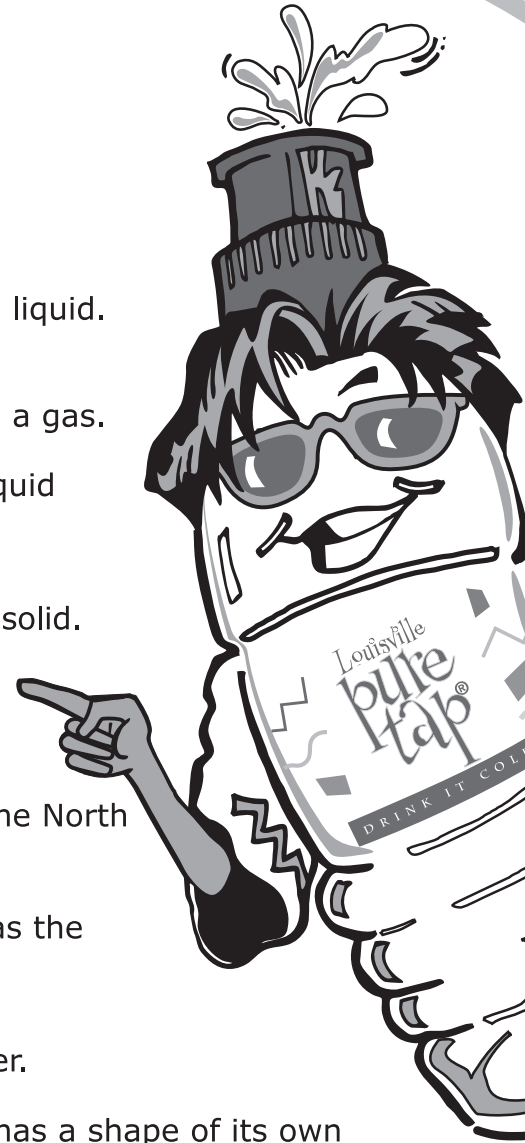
Liquid: a state of matter; a liquid always has the same shape as its container.

Molecule: one or more atoms that mix together.

Solid: a state of matter; a solid generally has a shape of its own and has a constant volume.

Volume: the amount of space an object occupies.

Water vapor: water as a gas.



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Activity #1: The Case of the Disappearing Water!

Objective:

Students will understand how water changes from a liquid to a gas.

Time:

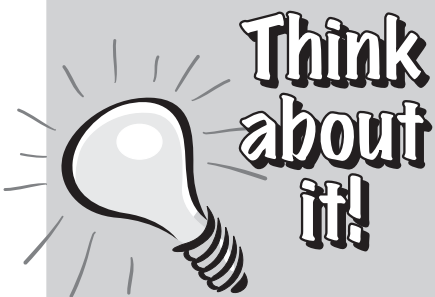
Thirty minutes for the story. Several days to conduct the experiment and follow-up.

You'll need:

- Clear measuring cups
- Water
- Copies of "The Disappearing Water Activity Sheet"
- "The Case of the Disappearing Water" story

Here's what to do...

1. Explain to the students they're about to become "water detectives."
2. Either read aloud during class or have students read the story, "The Case of the Disappearing Water."
3. Divide the students into small groups. Have each group fill out the activity sheet. It's important they form a hypothesis before they do the experiment.
4. Perform the water experiment to see what really happened to the water.
(*Directions for the experiment are on the activity sheet.*)
5. Make sure students remember to check the water level each day. To add another math portion to this experiment, have students graph the results.
6. When the experiment is over, be sure the students record their results and conclusions.



These questions are great for follow-up!

If some groups had different results with the experiment, why do you think this happened?

How would weather conditions (sunny or cloudy day) affect the experiment?

The Case of the Disappearing Water!

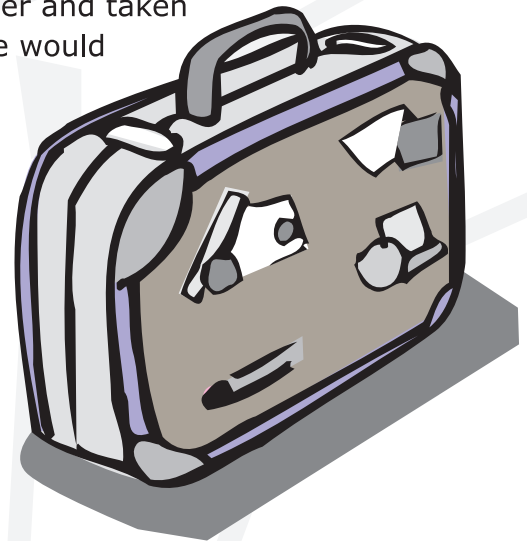
By
Susan M.
McMaster

The Water Detectives Anonymous were called to the home of Mrs. Flowers. When they arrived on the scene, Mrs. Flowers' grown son, Frank Flowers, was frantic. His mother was missing! The detectives asked Frank how long his mother had been missing. "That's just it," Frank said. "I've been traveling a lot and kept forgetting to phone her. Now I feel terrible. I have no idea where she is or how long she's been missing." "Do you know of some places where she might have gone?" asked one water detective.



Frank wrinkled his brow and thought hard. "Well," he said, "her habits are very predictable. If she has been gone less than a day, she probably just went shopping. If she's been gone fewer than 3 days, she may be visiting one of her sisters. She always says 'Guests are like fish, they start to stink in 3 days!' She would never visit anyone for more than 3 days."

"If she's been gone more than 3 days, but fewer than 7," continued Frank, "she's probably taking a vacation on a cruise ship. I'm sure she can't afford more than a 7-day cruise. If she's been gone more than 7 days but fewer than 6 weeks, she's probably received the grant that she applied for – she wants to study art in Europe. If she's been gone more than 6 weeks, she is probably at her mountain cabin. However, she never stays there more than 2 months. If she's been gone longer than 2 months, aliens must have captured her and taken her to another galaxy. She loves her plants and her home. She would never stay away longer than 2 months for any reason."



The Case of the Disappearing Water!

(continued)



"I think we can help you solve this mystery," said another water detective who had been looking around the house. "Did you find a note?" asked Frank hopefully. "No," said the detective, "but I did find this glass measuring cup in the window." "Oh," said Frank, "that's nothing. Mother is very particular. Every morning she fills the measuring cup to exactly one cup. Then she puts it in the window sill to warm in the sun for a little while before she waters her African violets. She is very careful about how much water she uses because she doesn't want to over-water or under-water the plants." "Aha!" said the water detective, "Just as I suspected, this is precisely where we must begin our search. The measuring cup now has exactly $\frac{3}{4}$ of a cup of water." "Are you saying someone stole $\frac{1}{4}$ cup of water?" asked Frank.



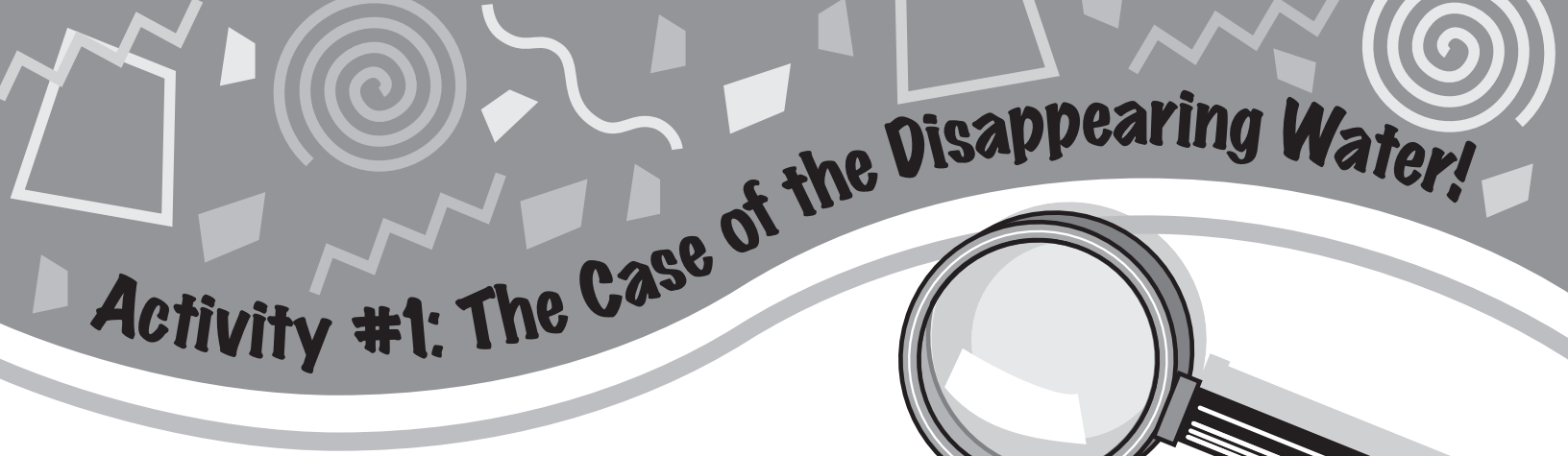
"No wonder his mother didn't bother to tell him where she was going!" muttered one of the detectives.

"No sir," said another water detective, trying to keep a straight face. "It's a matter of evaporation. You see, water evaporates into the atmosphere. The warmth of the sun changes the liquid into water vapor that we can't see. After awhile the water vapor condenses and forms into clouds. Eventually the water comes back to the ground as rain or snow or hail. Over time, the water evaporates again. It's part of the water cycle."

"To make a long story short," said another detective, "We're going to conduct an experiment. We'll put a cup of water in a sunny place and keep track of how long it takes to evaporate. Based on that experiment, we will estimate how long ago Mrs. Flowers left the measuring cup in the window sill."

"What a relief!" said Frank. "What should we do now?"

"I suggest you water the plants," replied yet another detective.



Activity #1: The Case of the Disappearing Water!

Okay water detectives! Let's get the facts from the story first.

1. What's the original amount of water in the measuring cup? _____
2. What's the amount of water in the measuring cup now? _____
3. If Mrs. Flowers has been gone for less than a day, she probably _____.
4. If Mrs. Flowers has been gone for three days, she may be _____.
5. If Mrs. Flowers has been gone for seven days but fewer than six weeks, she's probably _____.
6. If Mrs. Flowers has been gone for more than six weeks but fewer than two months she is _____.
7. If Mrs. Flowers has been gone longer than two months, _____.

Now, develop a hypothesis. That means, what's your prediction? What will happen in the experiment?

How long do you think the water was left on the window sill? _____

Where do you think Mrs. Flowers went? _____

Now – do the experiment to see what really happened to the water and where Frank should look for Mrs. Flowers. Each group needs a clear measuring cup and water.

Here's what you do:

1. Write down today's date _____.
2. Fill the measuring cup to the one cup line.
3. Put the cup in a sunny window.
4. Write down how many days it takes for the water in the measuring cup to be at the $\frac{3}{4}$ cup line. Use the sheet on page 3-9 to record your data.

What did you learn?

1. It took about _____ days for the water to drop to the $\frac{3}{4}$ cup line.
2. Where should Frank begin looking for Mrs. Flowers? _____

Now – the big question.....What happened to the water?

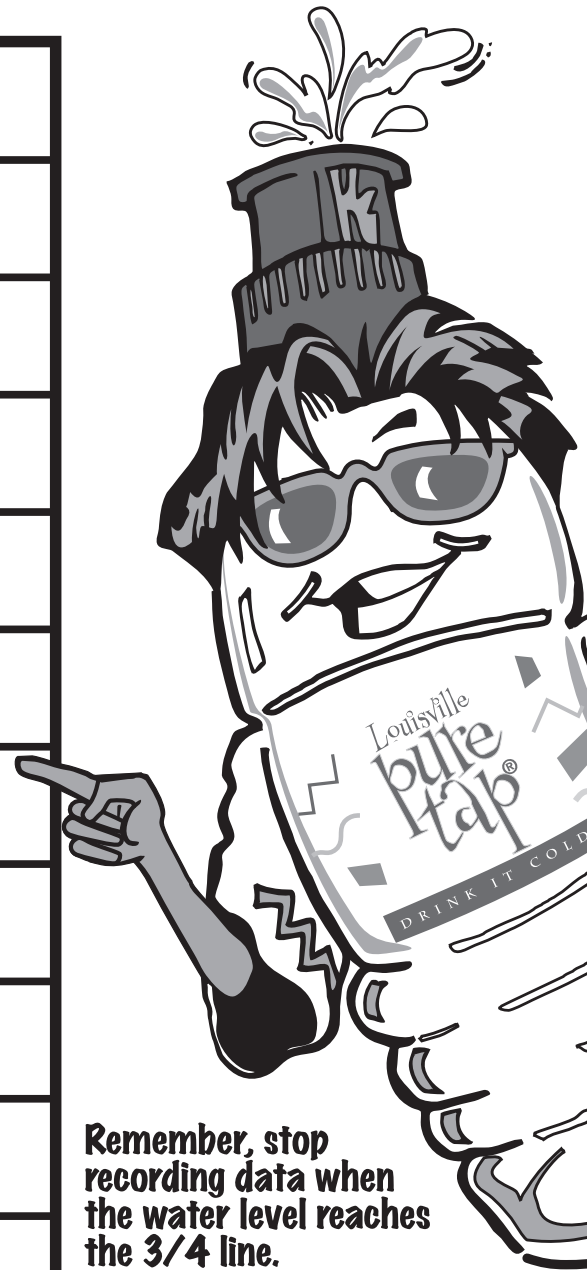
Activity #1: The Case of the Disappearing Water!

Record your data

Today's date: _____

(this is the day you filled the measuring cup to the one cup line.)

Day	Water level in cup
Day 1	1 cup
Day 2	
Day 3	
Day 4	
Day 5	
Day 6	
Day 7	
Day 8	
Day 9	
Day 10	



Remember, stop recording data when the water level reaches the $\frac{3}{4}$ line.

Activity #2: The Freeze Factor

Adapted from "Hypermedia Textbook for Elementary Kids."

Objective:

Students will learn that as water changes from a liquid to a solid it expands.

Time:

Thirty minutes to start the experiment, several hours to see the results.

You'll need:

- Clear straw
- Small baby food jars
- Red or blue food coloring
- A permanent marking pen
- Marble size piece of clay

Here's what to do...

You can do this either in small groups, as a demonstration or individually.

1. Press the ball of clay into the bottom of the center of the jar.
2. Fill the jar with water.
3. Add four or five drops of food coloring and stir.
4. Put the straw into the water and push it into the bottom lump of clay. Now the straw can stand on its own. Water should fill into the straw.
5. Slowly pour all of the water out of the jar. Keep the water in the straw.
6. Use the pen to mark the height of the water in the straw.
7. Put the jar in the freezer for about four hours or until it's completely frozen. Don't touch while it's in the freezer.
8. Remove the jar from the freezer. Where's the water in the straw? Is it above or below the mark you made? (The frozen water should be above the mark you made.)

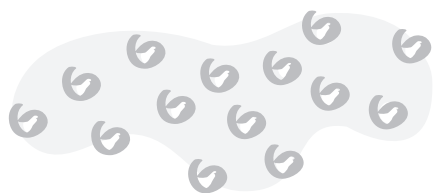
What did you learn?

Water is made up of molecules and these molecules are attracted to each other. When water is a liquid, the molecules move around. As water gets colder and freezes the molecules have limited movement and end up farther apart. That's why water expands as it freezes. Ice is less dense than water, which is why ice floats on top of water.



WORKSHEET

Make sure you get the right state of the water!



Water can exist in three states:

Think of two ways water can be a solid.

Think of two ways water can be a liquid.

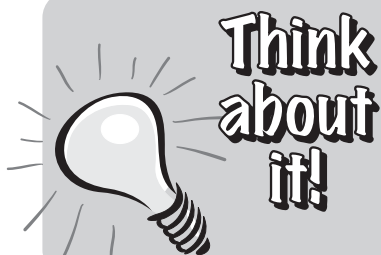
What's so special about the shape of a liquid?

Think of a way water can be a gas. _____

Water can change from state to state!

As water changes from a gas to a liquid, it's called _____.

As water changes from a liquid to a gas, it's called _____.



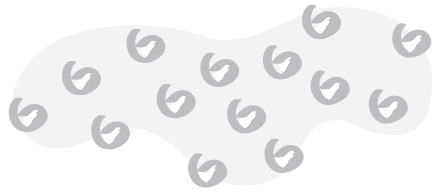
Ice can float on water. (Think of an ice cube.)

Think about the ice you see on the pond in the winter. Why is this important to a fish in the winter?



WORKSHEET ANSWERS

Make sure you get the right state of the water!



Water can exist in three states:

solid

liquid

gas

Think of two ways water can be a solid.

ice cube, popsicle, glacier, hail

Think of two ways water can be a liquid.

river, drinking water, ocean

What's so special about the shape of a liquid?

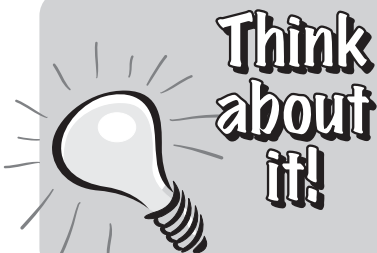
it always takes the shape of the container it's in.

Think of a way water can be a gas. air or clouds

Water can change from state to state!

As water changes from a gas to a liquid, it's called condensation.

As water changes from a liquid to a gas, it's called evaporation.



Ice can float on water. (Think of an ice cube.)

Think about the ice you see on the pond in the winter. Why is this important to a fish in the winter?



I'VE GOT THREE STATES

Check out these opportunities to keep the learning flowing!



Extra, Extra, Extra!!!

Books:

Ardley, N. (1991). *The science book of water*. New York, NY: Gulliver Books.

Learning, T. (1994). *Water*. New York, NY: Graham Peacock.
Book contains additional water experiments.

Robbins, K. (1994) *Water*. New York, NY: Kenry Hoit and Company.

Graham, J. (1994). *Splish splash*. New York, NY: Ticknor & Fields Books for Young Readers. *Collection of poems about water in its various forms.*

Web sites:

www.eddiefiles.org/mathtrails/nycwater *Site is maintained by a group of New York students about New York City's water. Good section on the properties of water.*

www.wested.org/werc/earthsystems/water *Click on "water projects."*

Louisville Water Company Opportunities:

Call the Public Information Office at 569-3600 to schedule water experiments in your classroom. LWC will come to you for some water fun!

www.tappersfunzone.com *Click on "Teacher Tools" for a supplement to this section.*